Automobile Lubrication.—Some Elementary Principles.

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The successful operation of any kind of automobile, be it a touring car, commercial vehicle, motor cycle, or motor boat, depends to a great extent on the proper lubrication of all the many working parts, a fact which is very often overlooked by both owner and chauffeur, and which results in shortening the life of the vehicle and in large repair bills. If a car has been neglected for any length of time, as far as conscientious lubrication is concerned, nearly every moving part becomes badly worn. Fifty per cent of all repair bills could easily be saved if the chauffeur would lubricate the entire car systematically.

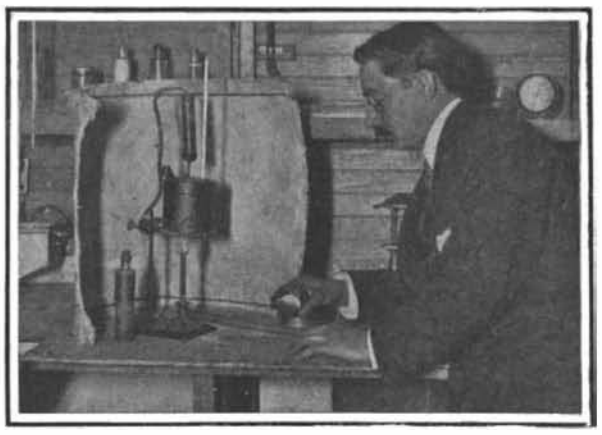


Fig. 1.—VISCOSITY TEST.

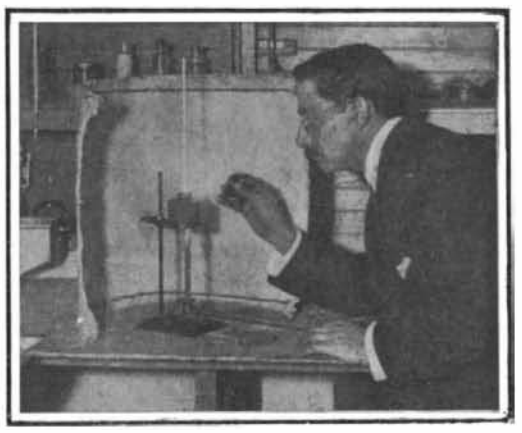


Fig. 2.—FLASH TEST.

Of all the troubles which may occur, those resulting from faulty lubrication are the most serious because they can be remedied usually only after long delay on the road. In many cases, however, the car must be towed home, so that the defective part may be renewed. Other troubles, such as those caused by faulty ignition, carburetion, or even tire troubles, can be remedied quickly. Moreover, the chauffeur is usually warned in these cases. Lubrication troubles, however, appear suddenly.

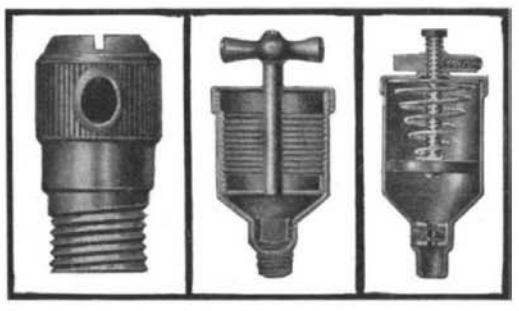
To be able to lubricate our car properly, it is absolutely necessary to have a system of lubricating. In other words, we must lubricate certain parts daily, some weekly, and others monthly. In addition, we must understand the nature of the lubricants used, and the devices employed to take care of the individual lubrication of bearings. We must familiarize ourselves, therefore, with the following:

1. Lubricants, their nature in general.
2. Lubricants used on a car, which may be subdivided into the following groups: (a) Liquid lubricants (cylinder oils). (b) Semi-liquid lubricants (non-fluid oil, vaseline, greases). (c) Solid lubricants (graphite).
3. Lubricating oil tests: (a) Specific gravity. (b) Viscosity. (c) Evaporation or volatility. (d) Flash and fire test. (e) Cold test. (f) Acid test.
4. Lubricating systems: (a) Grease cups. (b) Gravity feed. (c) Pressure feed. (d) Mechanical force feed. (e) Splash system.
5. How to lubricate the car systematically: daily, weekly, semi-monthly, monthly.
6. General remarks.

Lubricants: Their Nature in General.—The majority of oils and lubricants marketed as automobile oils to-day by a very large number of concerns are made by the Standard Oil Company. Numbers of small jobbers have helped considerably to confuse matters by selling one of the Standard Oil Co.'s ordinary machinery oils as a special automobile oil.

Hydrocarbon oils are strictly mineral oils, free from acid, and having petroleum as a basis. They are subdivided into residual oils and distillate oils. Residual oils are the products left over after the more volatile oils (gasoline, kerosene) have been volatilized during the process of distillation. They consist of hydrogen and carbon only. Distilled oils are produced by distilling, deodorizing, and coloring by chemical treatment the petroleum tar which is left after all residual oils have been obtained. The lubricating qualities of a mineral oil are greatly increased by compounding or mixing it with some fatty oil (animal or vegetable), such as sperm, lard, tallow, fish oil, or vaseline. At high temperatures most of these oils, however, lose their lubricating qualities. Vegetable and animal oils are liable to decompose at high temperatures and then liberate acids (injurious to metal) or tar. To the group of animal oils belong: (a) The blubber of the whale (sperm-oil); (b) neatsfoot oil, from boiled cattle feet; (c) lard oils; (d) tallow; (e) fish-oils.

To the group of vegetable oils belong: (a) linseed oil, obtained by compressing flax seed; (b) cotton-seed oil, produced by grinding, steaming, and pressing the seed of the cotton plant; (c) olive oil, from olives;



Oil cover. Grease cup. Grease cup.

Fig. 3.—TYPICAL LUBRICATING DEVICES.

(d) palm oil, from African palm nuts; (e) resin oil, produced by distilling the resin of pine trees; (f) castor-oil.

As far as the origin of petroleum or crude mineral oil is concerned, it must be said that the opinions of scientists, chemists, and geologists still differ considerably. Some say that crude oil comes from inorganic substances, while others claim that it is of organic origin. At any rate, one fact remains: All mineral cylinder lubricating oils contain carbon, although some manufacturers try to impress on the public that their products "will not char," "contain no carbon whatever," or "will deposit no carbon." These broad claims show how very, very little some oil dealers seem to know about their own products. While all oils deposit some carbon, different brands will deposit different percentages of carbon, depending also on conditions in cylinders.

Obviously, the oil that deposits the least carbon will be the best to use. By filtering an oil, one can reduce its carbon-producing qualities. The more an oil is filtered, the lighter and clearer in color it becomes. In its natural state, oil is greenish black to dirty dark brown in color. A completely filtered oil would be water white or colorless. Partially filtered oils are of a reddish, yellowish, or straw color.

Liquid Lubricants (Cylinder Oils).—Marine steam engines are strictly high-speed engines, the steam itself being of very high pressure and high working temperature. Therefore oils which may give perfect satisfaction on slow-running, low-pressure stationary steam engines cannot be used. A good automobile steam-engine oil should have the following qualities: High flash test (600 deg.), and sufficient viscosity to adhere to the very hot cylinder walls. The table will enable the reader to compare some of the best-known oils on the market to-day. For obvious reasons manufacturers' names have been omitted. The writer advises that every owner comply with the lubricating directions furnished by the manufacturer of the car. This is the cheapest and best course to follow, for the maker of the car has in most cases tried out a large number of leading lubricants, and if he recommends a certain brand, he does it only because he has found it particularly satisfactory.

Gas-Engine Cylinder Oils.—In cylinder and piston lubrication, where very high temperatures prevail, not only the viscosity and purity but also the flash point will have to be considered. The flash point should not be below 410 deg. F. Cylinder oils should not decompose at high temperatures. The price varies from 50 cents to 75 cents a gallon wholesale. Inferior oils cause knocking and gumming of rings.

Semi-Liquid Lubricants (Non-fluid Oils, Vaseline, Greases).—To this group belong the partially liquefied oils, which should be free from acid and manufactured from mineral oils only. Generally they exist in a plastic condition, flowing slowly to the bearing,

TESTS OF SOME LEADING LUBRICATING OILS.

Brand.	Specific Gravity.	Viscosity at 212 Deg. F.	Flash Point, Deg. F.	Fire Point, Deg. F.
1	0.882	59	450	500
2	0.919	57	415	480
3	0.910	57	365	410
4	0.880	73	435	510
5	0.875	51	450	500
6	0.900	120	500	560
7	0.892	57	410	500
8	0.869	47	420	480
9	0.868	50	435	480
10	0.892	55	500	560
11	0.905	27	400	450
12	0.895	47	420	470

and beginning to lubricate as soon as applied. Non-fluid oils (vaseline) have special oil cups in which the lubricant is forced to the bearing by spring pressure (Fig. 3). When using greases, however, screw pressure cups turned by hand are employed. Greases in general are nothing but mineral oils, thickened with tallow, soaps, graphite, chalk, starch, etc. Some of these ingredients, added to thicken the oils, actually increase their lubricating quality. This is true of graphite. More often, however, they increase the manufacturer's profit. They are employed to lubricate steering connections, wheels, water pumps, universal joints, ball bearings, and transmissions and main-bearings of 2-cycle engines.

Non-fluid oils are mineral oils so treated as to be-

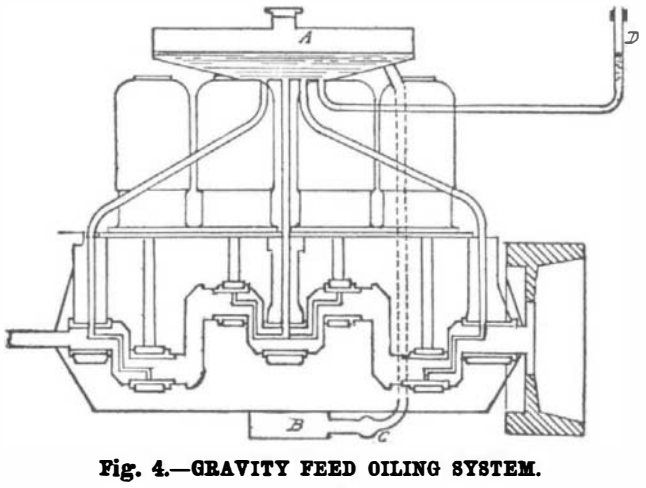


Fig. 4.—GRAVITY FEED OILING SYSTEM.

The oil flows from the crankshaft into the oil well *B*, and is pumped from there into the tank *A* at the cylinder heads. It flows by gravity to the main bearings and oilways drilled in the crankshaft to the connecting-rod bearings. The oil pump, not shown, is at *C*. *D* is a glass showing height of oil in the reservoir.

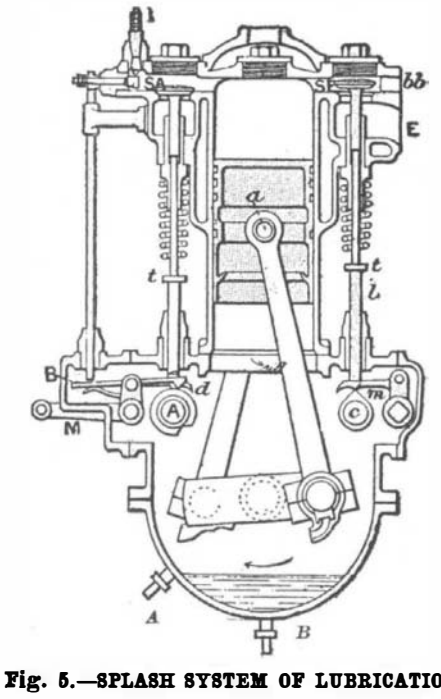


Fig. 5.—SPLASH SYSTEM OF LUBRICATION.

A is a cock to test level of oil. *B* is a drain cock.

come partially solidified. Their consistency varies but little with changes of temperature. They have the advantage over regular oil that they do not drip.

Solid Lubricants (Graphite).—Graphite is one of the best lubricators known and can be used in most parts of the car, added to the oil, which then carries it to the bearing proper. Mixed with grease, forming a heavy paste, it has been used successfully in slow-running journals, transmissions, or wherever very heavy surface pressures exist, or wherever oil does not permanently identify itself either with the journal or bearing but forms an intermediate film only, depending on the pressure transmitted and the viscosity.

Graphite forms hardly any film between rubbing surfaces, but associates itself with either one or the other or both working parts. It acts like a filler or veneer and is of great value when used on poorly surfaced machine-parts. It is marketed in two forms—amorphous (or powdered) and "flake"—and in connection with cup grease, universal-joint and gear-case compounds, good for chains and fiber cam-shaft gears. Mixed with quickly-drying shellac, it forms a rust-proof coating for rims. Threaded connections treated with a mixture of graphite and oil will form tight joints, but can nevertheless be easily removed.

Oil Tests.—As the conditions (temperature and pressure) under which lubrication must take place are so changeable throughout the various moving parts of an automobile, the greatest care should be exercised in selecting lubricants. To be able to judge oils it is necessary to be acquainted with the various tests which are made to determine their qualities. In the following these tests are as briefly described as possible.

1. *Specific Gravity.*—The relative weight of an oil as compared with that of water at a given temperature is called specific gravity of the oil, and is measured in degrees Baumé. Only manufacturers conduct specific gravity tests.

2. *Evaporation, or Volatility.*—The amount of oil lost by evaporation is determined by the saucer test, which consists in exposing an oil in a flat receptacle to a temperature of from 200 to 250 deg. F. for twelve to twenty-four hours. The test is made chiefly by manufacturers, but can be made by the automobile owner.

3. *Viscosity.*—Of all oil tests, this is probably the most important. By it we determine the fluidity or body of an oil at certain temperatures. For instance, the body or thickness of a cylinder lubricating oil at normal temperature is absolutely no guide to its lubricating quality. It will be much thinner at higher temperatures, such as we find in the cylinders of a gas engine, where the normal temperature is not lower than 200 deg. F. and rises to 350 deg. F. Viscosity, properly speaking, is the cohesion of the oil molecules, and defines their adhering qualities to the metal surfaces which they are to separate and lubricate at given temperatures and pressures. The viscosity test consists in determining the length of time in seconds it takes a certain amount of oil to flow through an aperture such as a small tube of a given size and length. The temperature of the oil is kept either at 100 deg. F. or 212 deg. F. It is essential that this temperature be carefully maintained throughout the test. The body of most oils raised to 300 deg. F. is only about 2 per cent to 6½ per cent of the body at 70 deg. F. (See Fig. 1.)

4. *Flash and Fire Tests.*—The flash point of a lubricating oil is the temperature which, a burning taper being held over the surface of the oil, will produce a flame. Only the vapors which have risen from the surface of the heated oil are ignited, however, and not the oil itself. Hence the flame is almost immediately extinguished. By the fire test, we determine the temperature at which an oil takes fire and continues to burn when brought in contact with a burning taper. (See Fig. 2.)

5. *Cold Test.*—Lubricants, in general, when exposed to low temperatures, congeal and set more or less, thereby clogging lubricators, oil feeds, etc., and ceasing to lubricate on the one hand or increase friction on the other. A motor is started with greater difficulty in cold than in warm weather. A large number of manufacturers put three grades of gas engine cylinder oil on the market. These are the light, medium, and heavy qualities, often called summer and winter oils. The cold test of a fairly light oil is the temperature at which the oil starts to congeal and stops flowing. When testing heavier lubricants, the oil to be tested is first frozen, and the temperature is taken at a point at which it starts to flow again. In a cold test for steam cylinder oil the congealing point is about 45 deg. F. Machine and engine

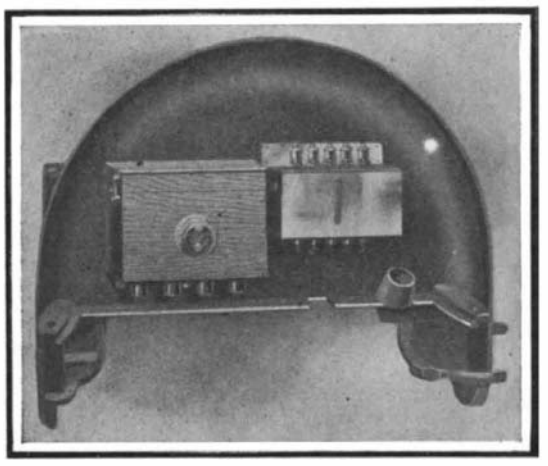


Fig. 9.—LUBRICATING DEVICES ON DASHBOARD.

oils congeal at about 32 deg. F. There are some light oils which are specially manufactured for winter use, having a cold test as low as 0 deg. F.

6. *Acid Test.*—When using greases or non-fluid oils for ball bearing lubrication, it is essential that they be free from both mineral acids and fatty acids (due to bad refining or presence of some fatty oil). A simple and practical method of testing for acid is to take a polished steel plate or rail and partly cover it with a strip of flannel or lamp wick which has been saturated with the lubricant to be tested. This done, it should be exposed to the sunlight for a day or two. The flannel should then be removed and the plate or rail wiped dry. If the lubricant is free from acid, the steel will have retained its old gloss. If, however,

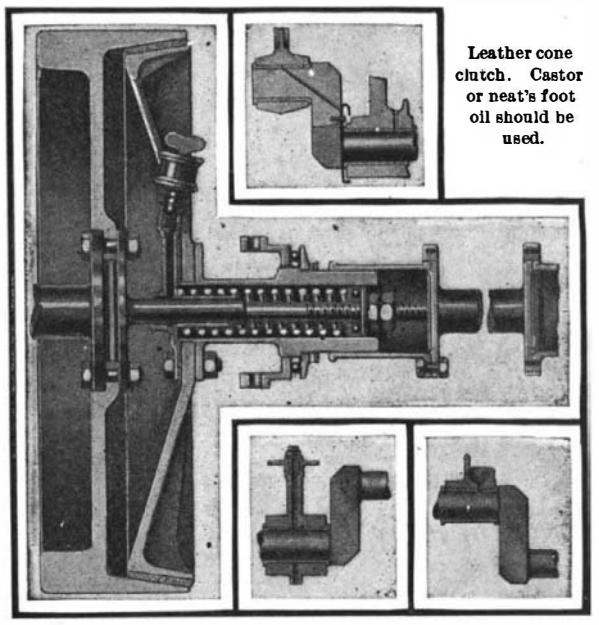


Fig. 10.—VARIOUS TYPES OF OILING SYSTEMS.

dull spots have developed on the surface covered by the flannel, it is a sure sign of the presence of acid.

Lubricating Systems.—*Grease Cups* (Fig. 3).—There are several types of grease cups in use to-day. These are: (1) Magazine grease cups, used to lubricate more than one bearing. In these a comparatively thin grease should be used. (2) Small grease cups located on the bearings proper. The grease is forced to the bearing either by spring pressure (thin grease or non-fluid oil) or by hand pressure (thick grease). In many instances the main shaft bearings of transmission cases are lubricated separately by grease cups, which are generally located under one of the side members of the frame. Care should be taken that the grease actually gets to the bearings, as the pipes leading from the cups to the bearings must be filled completely before any grease will lubricate the bearings. The ordinary commercial grease cup should not be used on automobile work, as the cap is very easily unscrewed by the vibration of the car and then falls off. Only self-locking cups are to be recommended.

The Gravity Feed System (Fig. 4).—Probably the simplest system used to convey lubricating oils to their respective bearings is the gravity system. The oil flows by gravity from a cup or a tank to the bearing through small copper pipes. The amount is regulated by a needle valve for a certain number of drops per minute, which can be counted as they leave the oiler and pass through a sight (glass) tube before entering the feed pipe. In cold weather care should be taken that the oil actually reaches its destination. If the oil proves too thick and a thinner grade cannot be procured at once, it may be thinned with a little kerosene. Perfectly clean oil should be used, for the least foreign matter is liable to stop up a small opening in the needle-valve through which the oil drops. When the system is used to lubricate engine cylinders, a pressure-tube must be provided inside of the gravity-feed cup, so as to allow for all back pressure from the cylinder.

The Splash System (Fig. 5).—This system is extensively used to lubricate the motor and transmission. The crank case is filled up to a certain level with cylinder lubricating oil, in which the revolving crankshaft and connecting rods dip, splashing the oil over the crank-case interior. In some cars the entire motor is lubricated by the splash system (cylinders, camshafts, and connecting rods). To replenish the lubricating oil in the crank case, the drain plugs on the bottom are first unscrewed to let the old oil run off. The crank case is then washed out with kerosene. This done, the drain plugs are screwed up tightly, and the pet-cock on the side of the base is opened. Oil is then filled in until it starts to run out of the pet-cock, which indicates that the proper level inside has been reached. This should be done every two weeks, besides daily pumping in a small amount with the dashboard hand pump, especially when touring. Usually, however, the cylinders and main bearings of the motor are lubricated by a dashboard oiler (force feed lubricator or pressure feed tank), and only the connecting rods are lubricated, Fig. 7, the oil being taken up through small copper tubes fastened to the connecting rod caps, from small troughs cast into the base chamber. Gears in transmission cases are also lubricated by this system. The oil level should be kept at least ½ inch below the lowest part of the gear-shaft bearing; otherwise the oil is liable to flow out of the case through one of these bearings. Light oil should be used when the main shaft bearings are of the plain type, some of the oil splashed by the gears being depended on to lubricate them. When ball bearings are used, a fairly light grease free from acid will do good service (vaseline).

Pressure System.—This system we can divide into three groups:

(a) The lubricating oil is carried in a tank which is placed in some convenient spot (generally under the footboards, seat, or frame), and is forced by pressure (exhaust or water) to the row of sight feeds on the dashboard, from which it flows by gravity to the respective bearings. (b) The oil is kept circulating by a plunger or gear pump through a main pipe under a given pressure and is branched off to each bearing individually through an adjustable sight feed and short pipe. This is a very reliable system to be recommended for motor racing boats. (c) Lubricating oil is forced by a gear or plunger pump, located in the base of the crank case, through internal leads in the motor to all the bearings in the motor. The pressure is kept at all times from 1 to 4 pounds. The cylinders are then often lubricated from a spray of oil that flies off from the connecting rods, which are fed by long internal leads in the crankshaft.

Mechanical Force Feed System (Fig. 6).—This system employs pumps which are mechanically driven by belts, chains, etc., from the camshaft. Generally we find two pumps for each feed. All are, however, housed in one casing, which acts as an oil reservoir and is generally fastened to the dashboard. One pump

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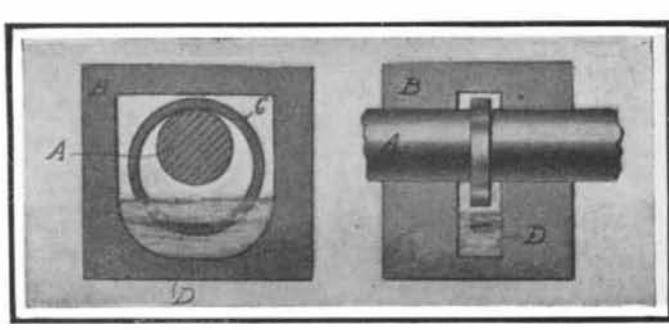

Fig. 8.—THE OIL RING SYSTEM.
A is the shaft; *B*, the bearing; *C*, oil ring; *D*, oil.

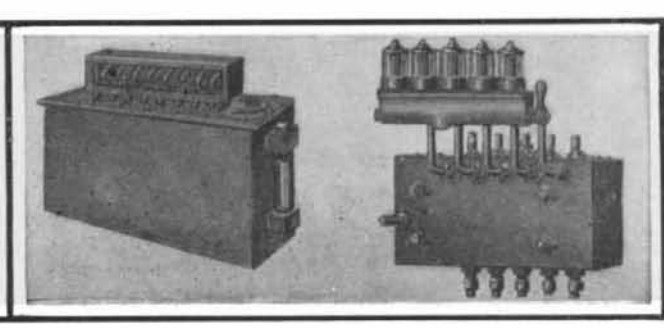

Fig. 6.—TYPES OF FORCE FEED LUBRICATORS.

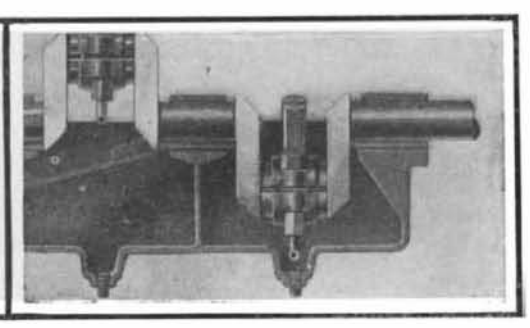

Fig. 7.—CRANKSHAFT LUBRICATION BY THE SCOOP SYSTEM.

AUTOMOBILE LUBRICATION—SOME ELEMENTARY PRINCIPLES.

(*Continued from page 49.*)

delivers oil from the reservoir to the sight feed above, where the proper amount is regulated. After dropping through the sight feed, a second pump forces the oil to the proper bearing. These lubricators should be closely watched, for the small ball-checks in the pumps often gum up and prevent the pump from working. It is advisable to obtain full instructions from the manufacturer of the lubricator, as there are a great number of these force-feed lubricators on the market which greatly vary in their construction and adjustment.

Hand Oil Pumps.—Hand oil pumps are sometimes found on the dashboard of cars which lead to the motor base. They should be given several full strokes daily.

LUBRICATION—HOW MUCH AND HOW OFTEN.

Part.	Lubricant.	Quantity.
Engine cylinder	Cylinder oil.	6-12 drops per minute.
Engine crank case	Cylinder oil.	Every 300 miles, or twice a month.
Engine bearings	Cylinder oil.	8 drops per minute.
Valve lifters	Machine oil.	With oil-can, daily.
Fan bearings	Machine oil.	1 drop every 2 minutes
Timer-shaft	Machine oil.	With oil-can, daily.
Pump shaft-drive	Machine oil.	With oil-can, daily.
Magneto-drive	Machine oil	With oil-can, daily.
Lubricator shaft	Machine oil.	With oil-can, daily.
Clutch release	Machine oil.	With oil-can, daily.
Break-lever-bearing	Machine oil.	With oil-can, daily.
Steering knuckle	Grease.	One turn daily.
Water pump	Grease.	One turn daily.
Clutch-shifting collar	Grease.	One turn daily.
Transmission bearings	Grease.	Two turns daily.
Outer bearing live rear axle	Grease or oil	Two turns daily.
Magneto, plain bearing	Dynamo oil.	Keep pockets two-thirds full. Wash out with kerosene once a season.
Magneto, ball bearing	Dynamo oil.	Small amount once a month.
Starting-crank bracket	Machine oil.	Few drops weekly.
Spring shackles	Machine oil.	Few drops weekly.
Make and break tappets	Machine oil.	Few drops weekly.
Pedal-shaft brackets.	Machine oil	Few drops weekly.
Speed-change-lever	Machine oil.	Few drops weekly.
Emergency lever	Machine oil.	Few drops weekly.
Brake supports	Machine oil.	Few drops weekly.
Brake equalizers	Machine oil.	Few drops weekly.
Control levers and joints.	Machine oil.	Few drops weekly.
Spring hangers	Machine oil.	Few drops weekly.
Steering gear-case	Grease	Every 2 weeks 3 turns or gunful.
Front and rear wheel-hubs, ball or roller bearing	Grease.	Monthly.
Front and rear wheel hubs, plain bearing	Graphite and oil	500 miles.
Leather boots of steer-rod joints and steer drag-rod joints.	Grease.	Monthly or 500 miles.

LUBRICATION—HOW MUCH AND HOW OFTEN.

Part.	Lubricant.	Quantity.
Transmission-case sliding gear system.	Gear case compound or heavy oils, or either mixed with about ten per cent of graphite.	Semi-monthly or 300 miles. Let gears dip.
Transmission case, individual clutch type.	Light motor oil and little graphite.	Every 300 miles.
Planetary transmissions.	Non-fluid oil, or oil and graphite.	Every 300 miles. Fill up no higher than shaft bearing.
Live rear axle housing.	Non-fluid oil or heavy steam engine cylinder oil, grease and oil	One quart every two weeks.
Universal joints	Grease	Remove covering 500 miles, inspect and repack.
Torsion and distance rods	Oil	Monthly.
Timing gears.	Non-fluid oil, graphite if exposed	Monthly.
Chains.	Chain graphite.	Twice a year boil in graphite and grease after washing well in kerosene.
Clutch leather.	[Vegetable] castor oil, neats foot oil	If clutch slips or leather gets hard, keep off machine oil.
Clutch multiple disk, steel on steel.	Spindle oil and kerosene, kerosene and little graphite.	Weekly.
Clutch multiple disk, leather on steel.	No oil, little graphite.	Weekly.
Internal expanding clutch.	Thin oil.	Weekly.
Friction disk transmission	Keep oil off friction surfaces, wash off with gasoline, dress with belt dressing or French chalk.	Renew friction compost every 1,000 miles.

As it is inconvenient, however, to carry too many kinds of lubricating oils with you, cylinder oil will take the place of machine oil called for in the table.

How to Save Money in Maintaining a Car.—

Follow out the oiling instructions of the manufacturer conscientiously and do not use your own judgment in the matter.

Do not let anything on your car, no matter how small it may be, rattle or loosen. Inspect your bolts weekly.

Keep your car clean, not only on the outside, but inside (under the hood and under the body).

Keep the tires well inflated, and the lugs well tightened.

When a new car is received, the first thing the purchaser does is to try out the machine. That should be the last instead of the first step. Instead of taking a spin, he should examine the mechanism in general, and the lubricating system employed in detail. He should convince himself that every part which requires oil has oil. Not until then is the machine to be taken out and tried.

The driver's eye should be glued on the oil sights. If any sight should fill up with oil, the car should be stopped and the trouble remedied. The efficiency and life of a car depend largely on proper lubrication. A new car should be lubricated rather too much than too little for the first two months at least. Oil should be kept from the tires.

The car should not be run when an unusual noise or squeak is heard. The cause should be ascertained (hot bearings, brakes, etc.). Oil should not touch the brake bands of the planetary transmissions or the brakes. During an all-day run, the grease cups should be looked at and screwed down occasionally. If the engine cranks hard in a warm place, either the cylinders or main bearings need oil; if in a cold place, however, the lubricating oil in cylinders may be a little too heavy.

Before going on an extensive tour, see that the engine base and gear case are filled properly.

Examine the grease cups, and fill the lubricator. If the car is shaft-driven, remove the cover of the rear axle housing and see that the large bevel gear dips into the lubricant.

Go over the entire car with oil can and wrenches. Pay particular attention to the clutch.

Every two weeks inject a liberal quantity of kerosene into the cylinders, turning the engine over several times by hand when engine is still warm. This will remove whatever carbon may have been deposited in the cylinders and between the cylinder walls and the piston rings and thereby assure a good compression, which is one of the most essential points in getting power.

Keep the belt on the mechanical oiler sufficiently tight to drive it, and never run the car unless the pump is working perfectly.

Squeaking bearings denote lack of oil.

Sudden falling off of power when running may be caused by insufficient lubrication (cylinder and main bearings)

In extremely cold weather and where the lubrica-

tor is exposed, an egg-cup full of gasoline or kerosene will keep the oil from becoming too thick and from causing trouble by clogging the small ball checks in the oil pumps.

Before putting on a new clutch lever it is advisable to soak it for 24 hours in water. When fastened to the clutch it should be given a liberal coating of castor oil, or better still, neatsfoot oil. It will take quite a time for the oil to soak into the leather properly, as the water must first evaporate, which takes quite some time.

To prevent the multiple disk clutches (metal to metal) from dragging after disengaging the clutch by the foot pedal, use only a very thin oil (spindle oil) mixed with kerosene. Good results have been obtained by taking ¼ cylinder oil (light) and ¾ kerosene.

Lubricating oils should always be strained before using, as grit and ground-up materials will obstruct oil-holes, pipes, etc.

Blue smoke issuing from the muffler denotes excessive cylinder lubrication or worn cylinders and has nothing to do with the mixture of gas.

THE COMMERCIAL TRUCK VS. THE HORSE.

(*Concluded from page 43.*)

to heavy vehicles, and it must be admitted that it possesses advantages in the smoothness with which the power may be applied and in the reserve power that may be called upon in emergencies. In the United States, however, this field is practically untouched.

The initial expense of an automobile equipment seems high to the man who is familiar with horses, and to reduce it many concerns are purchasing second-hand pleasure cars and fitting them with delivery bodies. There is no risk in making the purchase if the purchaser will have the chassis examined and properly overhauled, but he must realize that the car is suitable only for the delivery of light packages, and that it must have careful attention and handling. With the addition of suitable braces and trusses a fair load may be carried, but there can be no comparison, of course, with the cars that are designed and built for trucking purposes.

To get the fullest benefits from an automobile delivery service, it must be realized at the outset that everything about it is new, and that a stable foreman is rarely competent to give it the intelligent management that it requires. There must be regular and systematic inspection of the mechanism, correct adjustments maintained, and supervision exercised over every detail of handling, repair, and care. The ultimate cost of neglect and mishandling is out of all proportion, and it should therefore be possible to place full responsibility for a failure to lubricate or to attend to any other essential of the upkeep. Two weeks at the factory is not sufficient to change a stable hand into a competent driver, and a lack of smoothness in the handling of the car will be paid for in tires, bearings, and strains in the entire mechanism.

It is usual to see automobile trucks carrying loads far in excess of their rated capacity, and this is the most prolific cause of high repair bills. It is the custom of some manufacturers to protect their vehicles by underrating their capacity, and this also operates to protect the purchaser. Knowing that the car is likely to be overloaded, a truck that is capable of carrying a load of five tons will be rated at three tons; another method of protection that is practised is to limit the size of the body.

A business man will not purchase an electric lighting plant without engaging an engineer to tell him what he wants, to select the apparatus, and to supervise its installation. Yet he believes himself competent to purchase an expensive truck, and to evolve a system for its operation and maintenance. The exigencies of the situation are producing experts who are competent to examine into the conditions under which deliveries are made, who can report on the make and type of car best adapted to perform the work, and who can establish rules for its care. It is to a man of this class that a prospective purchaser should turn for assistance. There are many houses operating automobiles successfully, but the price that they have paid for experience is far in excess of the fee that would have been charged had an expert been employed at the outset.

The construction of pleasure vehicles is approaching a condition of standardization, and the designs undergo only slight changes from one year to another. That the automobile truck is likewise emerging from a formative condition is shown by the reduced importance of the alterations required for the elimination of the weak points that develop in service. The 1909 types are far superior to the earlier models in every respect; and if their purchasers exercise common sense and business judgment in their management, there should be no difficulty in obtaining from them the swift, efficient, and economical service that is so greatly to be desired.

HIGH-TENSION IGNITION BY MAGNETO.

(*Concluded from page 45.*)

as such, but this is an error; for while it produces a high-tension current, the magneto itself delivers a current of even lower voltage than the magneto used for the make-and-break system.

While the Remy and Eisemann systems are similar in that they use separate coils, the magneto construction is different. In the Remy the winding is separate from the armature core and is stationary, the core revolving within it. The core and winding are shown in Fig. 7. When the core is revolved within the pole pieces of the field magnets, the cylindrical portion within the winding becomes magnetized and demagnetized, currents being developed in the winding to correspond with the degree and rapidity of the changes.

The Bosch high-tension magneto differs from the Remy or Eisemann in producing a current of high voltage in the armature winding, and without the use of a separate coil, this construction being also common to the U. & H., the new Eisemann, the Witherbee, and Komet. Instead of but one winding, the armature carries two, the inner or primary consisting of a few layers of coarse wire, and the outer or secondary of a great number of layers of fine wire. The disposition of these windings may be seen in Fig. 1, and the complete armature with the field magnets in Fig. 8. One end of the primary winding is grounded on the armature core, and the other passes to the insulated part of the interrupter, Fig. 9. While in the Remy and Eisemann magnetos the interrupter is stationary and operated by a revolving cam, in the Bosch the two fiber wheels, serving as cams, are stationary, and the interrupter revolves with the armature. This arrangement makes it possible to conduct the current from the primary winding direct to the interrupter without the use of a commutator or of sliding brushes, the action of which might be interfered with by dirt or oil.

In the Remy magneto and in another type of Bosch the primary current is conducted direct to the interrupter without the use of a commutator or sliding brushes, on account of the use of the stationary winding, which is used in its construction.

During the revolution the grounded lever makes and breaks contact with the insulated part, offering the primary current a short circuit while the contact is closed. As may be seen from the diagram, the secondary winding is grounded on the live end of the primary, its live end being connected with the revolving part of a secondary distributer.

In order that a current may flow it must have a closed circuit, and this will be the condition of the primary winding while the interrupter lever is in contact